Preserving and identifying biosignatures in hot-spring deposits

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Travertines (hot-spring mineral precipitates) are known from the Palaeoproterozoic to the present day. In modern Italian hot-springs, for example, they form around mats and streamers comprised of anoxygenic photoautotrophs and sulphate reducers. These microorganisms may be entombed in the precipitating minerals, and they may also influence crystal growth. Either way, convincing biosignatures are found in modern hot-spring travertines. However much of the carbonate material found around hot spring vents is aragonite which is susceptible to alteration to calcite, both on the Earth's surface and during burial. This means that while siliceous hot-springs like the Devonian Rhynie Chert preserve biosignatures for the long-term, the preserved carbonate hot-spring record of ancient life is seen as more murky. Here we will report results of experimental alteration of natural hot-spring aragonite to calcite in the laboratory. These experiments are designed to simulate the processes that would occur during increasing burial of a hot-spring carbonate deposit, with materials imaged via electron microscopy before and after progressive alteration at a range of increasing temperatures and pressures. Electron Backscatter Diffraction is used to trace mineralogical changes. Stable isotopes (O and C of carbonates, and O of fluid inclusions) and Raman spectroscopy of organic materials are also being used to trace alteration of geochemical signatures. Results so far seem to show that textural alteration of (biotically mediated?) hot-spring aragonite to calcite is harder to achieve than alteration of biotically-produced bivalve aragonite to calcite. If confirmed then our results are favourable for long-term textural preservation of ancient and extra-terrestrial biosignatures in hot-spring carbonates.